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RADIUM MONITORING NETWORK

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of State Services
Division of Water Supply and Pollution Control
Region VIII
Denver, Colorado

Colorado River Basin Water Quality Control Project

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16. Abstracts

Release No. 2 contains available radium-226 and uranium results received through December 31, 1962, from analysis of composite water samples at the sampling locations of the Radium Monitoring Network established by the Colorado River Basin Water Quality Control Project. The Network is a surveillance system consisting of continuous surface water sampling at 23 significant locations through the basin. It assays the radiological content of river water over the entire basin. Tabular data are presented that are below the currently accepted MPS value for radium-226. The possible influences of radium contributed to the mainstem of the Colorado River by the Dolores River system is indicated.

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17b. Identifiers/Open-Ended Terms

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COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

RADIUM MONITORING NETWORK

Introduction

This report contains available radium-226 results received through December 31, 1962, from analysis of composite water samples at the sampling locations of the Radium Monitoring Network established by the Colorado River Basin Water Quality Control Project. This report is the second release of such data. It is planned to make similar information available in the future on more or less a quarterly basis.

The Radium Monitoring Network is a surveillance system presently consisting of continuous surface water sampling at twenty-three significant locations throughout the Colorado River Basin. The purpose of this network, ultimately to consist of about 27 sampling locations, is to assay the radiological content of river water over the entire Colorado River Basin on a continuous basis. On October 22-23, 1957, a conference on uranium milling wastes was held at Cortez Colorado, and was attended by representatives of the States of Arizona Colorado, New Mexico, and Utah, and the Public Health Service. At this meeting, a Radium Monitoring Network to provide needed continuous data was suggested. Accordingly, when the Colorado River Basin Project was organized, such a surveillance network was initiated.

In the late summer of 1960 a field reconnaissance trip was made to select tentative locations for Radium Monitoring Network sampling stations. The first continuous station was established in January 1961. As funds, equipment and manpower have become available, additional stations have been added to the network. Sampling began at the majority of locations late in 1961 Originally, a system of continuously operating automatic sampling devices was conceived. However, due to extreme climatic conditions occurring in the Basin, fluctuation of river stages, and lack of experienced local manpower, this concept has been modified. Currently seven stations are served by automatic sampling devices. The balance of active stations are sampled on a grab-sample basis three to six times a week by private individuals. Samples collected are routinely being composited on a monthly basis for analysis. However, in a number of cases analyses of weekly composites, and even two-day composites for one station have been undertaken.

In general, three criteria have been used in selecting the locations for the various Radium Monitoring Stations. A number of stations are located to provide information on base-line or background levels of radioactivity. These stations are located upstream of all radioactive waste sources and hence serve as a measure of naturally occurring or "background" radiological conditions. Other stations located downstream of uranium milling activities assess the effects of such industry on the dissolved radium content of the stream. Stations which will be established in the Lower Main-Stem Sub-Basin will aid in assessing the significance in this area of dissolved radioactive materials originating in the Upper Basin.

Twenty-three Radium Monitoring Network Stations are currently operating. Thirteen stations are located in the Upper Main Sub-Basin; seven stations in the San Juan Sub-Basin; two stations in the Green Sub-Basin; and one at the Northerly U. S.-Mexican Border. The Radium Monitoring Network will be expanded to its full coverage in the near future by addition of three sampling locations on the Main-Stem of the Colorado River in the river reach from Page, Arizona to Parker Dam.

General Remarks on Appended Data

1. When viewed as a whole, with the exception of two values at RMN Station 26, all of the reported data for dissolved Ra-226 are below the currently accepted MPC value for radium-226 in drinking water of 3.0 μμc/1. Specifically, combining all background and non-background stations, the data shows:*

Average Ra-226: 0.36 μμc/1
Range: 0.0 - 3.3 μμc/1
Number of samples: 323

2. Grouping all stations together which are unaffected by uranium mining and milling activities (background stations), the data shows:

Average Ra-226: 0.07 μμc/1
Range: 0.0 - 0.68 μμc/1
Number of samples: 67

3. The data from all non-background stations shows:

Average Ra-226: 0.44 μμc/1
Range: 0.02 - 3.3 μμc/1
Number of samples: 256

The above data illustrates other comparisons which are given as follows:

1. The possible influence of radium contributed to the Main-Stem of the Colorado River by the Dolores River system is indicated by the increase noted between stations RMN 6 (Colorado River above Fruita) and RMN 9 (Colorado River above Moab).

The data from these two stations are as follows:

RMN 6: Colorado River above Fruita, Colorado
Average Ra-226: 0.13 μμc/1
Range: 0.09 - 0.26 μμc/1
Number of samples: 9

RMN 9: Colorado River above Moab, Utah
Average Ra-226: 0.29 μμc/1
Range: 0.16 - 0.43 μμc/1
Number of samples: 13

* Discussion of data herin is representative of all results shown in this paper (Data Release No. 2) and also that reported previously in Data Release No. 1, October 1962.

Additional data and further evaluation are required however, before other than a tentative conclusion amy be reached regarding influence of the radiological content of the Dolores River upon the Colorado River.

2. Data from five stations in the San Miguel-Dolores River system show the following:

RMN 17: San Miguel River above Naturita, Colo. (Background Station)
Average Ra-226: 0.04 μμc/l
Range: 0.00 - 0.09 μμc/l
Number of samples: 28

RMN 18: San Miguel River above Uravan, Colorado
(below Vanadium Corporation of America mill)
Average Ra-226: 0.23 μμc/l
Range: 0.09 - 0.51 μμc/l
Number of samples: 31

RMN 20: San Miguel River below Uravan, Colorado
(below Union Carbide Nuclear Corporation mill)
Average Ra-226: 0.93 μμc/l
Range: 0.26 - 2.5 μμc/l
Number of samples: 29

RMN 21: Dolores River at Bedrock, Colorado
(below Union Carbide Nuclear Corp. mining and milling at Slick Rock)
Average Ra-226: 0.52 μμc/l
Range: 0.08 - 1.0 μμc/l
Number of samples: 13

RMN 26: Dolores River at Gateway, Colorado
(below all mining and milling in the Dolores-San Miguel River system)
Average Ra-226: 1.6 μμc/l
Range: 0.04 - 3.3 μμc/l
Number of samples: 22

These data clearly show the effect of uranium milling activity in the Uravan-Naturita area on the dissolved radium entering the San Miguel-Dolores River system. The dissolved radium is apparently increased from a background level of 0.04 μμc/l to 0.23 μμc/l below the Vanadium Corporation of America mill near Naturita and to 0.93 μμc/l below the Union Carbid Nuclear Corporation mill at Uravan. The dissolved radium content is further increased to 1.6 μμc/l further downstream at Gateway, Colorado.

This further increase at RMN 26, some 33 miles downstream of the Uravan mill, is perhpas in part attributable to one or more small creeks entering the Dolores River below the Uravan mill. One such tributary,

Mesa Creek, was found to contain a dissolved radium content as high as 12.1 μμc/l in March 1962. Leaching of radium from the river bottom sediments may also be a factor in the increase noted in RMN 26.

It is further noted that the dissolved radium content of the San Miguel River above Uravan has increased gradually since November 1961. This increase would appear to be the result of the beginning of upgrading activities at the Vanadium Corporation of America mill late in 1961. The average radium-226 values of 0.93 μμc/l below Uravan (RMN 20) and 1.6 μμc/l at Gateway (RMN 26) are lower than the average values of 2.4 μμc/l and 5.5 μμc/l, respectively, found in 1960 at these locations, 1/ and indicate improved radiological conditions below the Uravan mill. However, it should be pointed out that these results are the highest encountered in the Radium Monitoring Network.

Of the 323 radium results which have been obtained to date, 22 values (or 7 percent are greater than 1.0 μμc/l. Of the 22 values higher than 1.0 μμc/l 21 were obtained from the five stations on the San Miguel and Dolores Rivers.

Excluding backgrouns location stations (Stations 1, 11, 13, 17, 22, and 24) 256 results have been obtained from stations affected by uranium mining and milling activity.

3. The data from the two stations on the Animas River are summarized below:

RMN 11: Animas River at Durango, Colorado (background station)
Average Ra-226: 0.05 μμc/l
Range: 0.04 - 0.06 μμc/l
Number of samples: 7

RMN 12: Animas River at Colorado-New Mexico State Line
Average Ra-226: 0.37 μμc/l
Range: 0.11 - 1.0 μμc/l
Number of samples: 33

These results indicate a substantial improvement in the radiological condition of the river below the Vanadium Corporation of America, Durango mill.

The average radium-226 value of 0.37 μμc/l is considerably lower than the average value of 7.6 μμc/l found during the summer of 1958 at

1/ "Survey of Interstate Pollution of the Animas River (Colorado-New Mexico)", Public Health Service, Colorado River Basin Water Quality Control Project, Denver, Colorado, September 1961.

this station. 1/ The information presented above shows the considerable merit of a radium monitoring network in the Colorado River Basin and the ability of such a network to distinguish clearly between background versus non-background conditions in the Basin with regard to radium-226. Ther variability observed in the raw data is no more than would be expected on the basis of flow patterns and sampling techniques.

The data reported for all stations in the Radium Monitoring Network since the Data Release of October, 1962 are amended.

1/ "Survey of Interstate Pollution of the Animas River (Colorado-New Mexico)", Public Health Service, R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio, May 1959.

RMN Station 1: Colorado River at Silt, Colorado
Started: November 25, 1961
Type: Automatic Pump-timer - 1 week composites

Date	μμc Radium-226/liter
1962	
April 28-June 3	0.04
June 3-30	0.05
June 30-July 28	0.11
July 28-Sept. 1	0.17
September 1-29	0.20

RMN Station 4: Colorado River above DeBeque, Colorado
Started: November 12, 1961
Type: Automatic Pump-timer - 1 week composites

Date	μμc Radium-226/liter
1962	
March 3-31	0.14
March 31-Apr. 28	0.10
July 28-Sept. 1	0.17
September 1-8	0.18
September 8-15	0.24
September 15-22	0.19
September 22-29	0.23

RMN Station 5: Gunnison River above Grand Junction, Colorado
Started: April 16, 1962
Type: Six dialy grab samples per week

Date	μμc Radium-226/liter
1962	
July 30-Sept. 1	0.09
September 3-8	0.10
September 10-15	0.10
September 17-22	0.10
September 24-29	0.03

RMN Station 6: Colorado River near Fruita, Colorado
Started: April 16, 1962
Type: Six daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 30-Sept. 1	0.21
September 3-8	0.26
September 10-15	0.19
September 17-22	0.21
September 24-29	0.13

RMN Station 5: Colorado River above Moab, Utah
Started: December 11, 1961
Type: Six daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 2-23	0.26
July 31-Sept. 1	0.36
September 3-8	0.43
September 10-15	0.31
September 17-22	0.16
September 24-29	0.34

RMN Station 10: Colorado River below Moab, Utah
Started: December 11, 1961
Type: Six daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 2-28	0.34
July 30-Sept. 1	0.49
September 3-8	0.31
September 10-15	0.43
September 17-22	0.33
September 24-29	0.21

RMN Station 11: Animas River at Durango, Colorado
Started: July 17, 1961
Type: 6 daily grab samples per week 7/17-9/9/61 except as noted

Date	µµc Radium-226/liter

No additional data

RMN Station 12: Animas River at Colorado-New Mexico State Line
Started: January 19, 1961
Type: Automatic

Date 1962	μμc Radium-226/liter
March 12-17	0.11
March 26-April 2	0.33
July 30-Sept. 3	0.34
September 3-10	0.35
September 10-17	0.41
September 17-24	0.35
September 24-Oct. 1	0.29

RMN Station 13: San Juan River above Farmington, New Mexico
Started: July 9, 1962
Type: Automatic

Date	μμc Radium-226/liter
1962	
July 9-23	0.03

RMN Station 14: San Juan River at Fruitland, New Mexico
Started: August 1, 1962
Type: Automatic

Date	μμc Radium-226/liter
1962	
August 1-6	0.15

RMN Station 14S: San Juan River below Shiprock, New Mexico
Started: August 7, 1962
Type: Automatic

Date	μμc Radium-226/liter
1962	
July 9-30	0.16
August 7-20	0.15
September 14-21	0.13
September 24-Oct. 1	0.15

RMN Station 16: San Juan River below Mexican Hat, Utah
Started: December 11, 1961
Type: 6 daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 30-Aug. 11	0.46
August 13-14	0.28
August 15	0.39
August 16	0.36
August 17	0.26
August 18	0.18
August 20	0.28
August 21-Sept. 1	0.54
September 3-8	0.21
September 10-15	0.21
September 17-22	0.24
September 24-29	0.35

RMN Station 17: San Miguel River above Naturita, Colorado
Started: October 20, 1961
Type: Automatic

Date	μμc Radium-226/liter
1961	
November 25-Dec. 2	0.02
December 2-9	0.04
December 7-17	0.01
1962	
July 28-Sept. 3	0.09
September 3-29	0.06

RMN Station 18: San Miguel River above Uravan, Colorado
Started: October 27 1961
Type: Automatic

Date	µµc Radium- 226/liter
1961	
November 25-Dec. 2	0.11
December 2-9	0.15
December 9-17	0.14
1962	
March 13-24	0.13
March 14-April 1	0.16*
Apr 1 1-25	0.23
May 7-13	0.23
July 23-Sept. 3	0.36
September 3-9	0.49
September 9-16	0.51
September 16-23	0.26
September 23-29	0.13

*Erroneously reported as 0.23 in Data Release No. 1, October 1962.

RMN Station 20: San Miguel River below Uravan, Colorado
Started: October 9, 1961
Type: Automatic

Date	μμc Radium-226/ liter
1961	
November 22-Dec. 2	0.85
December 2-9	0.66
1962	
April 1-15	1.0
April 23-28	0.26
July 28-Aug. 6	0.44
August 6-12	0.59
August 12-19	0.78
August 19-26	0.89
August 26-Sept. 3	0.81
September 3-9	0.79
September 9-16	0.99
September 16-23	0.39
September 23-29	2.5

RMN Station 21: Doloras River at Bedrock Colorado
Started: October 30, 1961
Type: 6 daily grab samples per week

Date	μμc Radium-226/ liter
1962	
July 30-Sept. 1	0.43
September 3-29	0.56

RMN Station 22: Tomichi Creek above Gunnison, Colorado
Started: December 11, 1961
Type: 6 daily grab samples per week

Date	μμc Radium-226/liter

No additional data

Station discontinued on July 1 1962

RMN Station 24: Gunnison River above Gunnison
Started: December 11 1961
Type: 6 daily grab samples

Date	µµc Radium-226/liter
1962	
January 2-27	0.05
January 29-Mar. 3	0.07
March 5-31	0.06
April 2-2[illegible]	0.04
April 30-June 2	0.04
June 4-30	0.04
July 2-28	0.02
July 30-Sept. 1	0.03
September 3-29	0.63

RMN Station 25: Gunnison River below Gunnison, Colorado
Started: December 11, 1961
Type: Six daily grab samples per week

Date	μμc Radium-226/liter
1961	
December 11-31	0.04
1962	
January 2-27	0.03
Jan. 29-March 3	0.06
March 5-31	0.03
April 2-28	0.02
April 30-June 2	1.1
June 4-30	0.04
July 2-28	0,02
July 30-Sept. 1	0.04
Sept. 3-8	0.03
Sept. 10-15	0.04
Sept. 17-22	0.21
Sept. 24-29	0.04

RMN Station 26: Dolores River at Gateway, Colorado
Started: October 30, 1961
Type: Six daily grab samples per week

Date	μμc Radium-226/liter
1961	
October 30-Dec. 2	0.04
December 4-30	0.89
1962	
January 1-27	1.3
January 29-March 3	1.0
March 5-31	0.79
April 2-28	0.54
April 30-June 2	0.71
June 4-30	0.81
July 2-28	1.4
July 30-Sept. 1	2.0
September 3-4	0.05
September 5-6	2.8
September 7-8	2.7
September 10-11	3.3
September 12-13	3.0
September 14-15	3.3
September 17-18	2.8
September 19-20	2.9
September 21-22	2.2
September 24-25	0.74
September 26-27	0.73
September 28-29	0.65

RMN Station 28: Yampa River at Maybell, Colorado
Started: July 2, 1962
Type: Three daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 2-28	0.03
July 30-Aug. 25	0.10
Aug. 27-Sept. 29	0.15

RMN Station 29: Green River at Green River, Utah
Started: July 16, 1962
Type: Three daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 16-27	0.08

RMN Station 30: Colorado River at Northerly U. S.-Mexican Border
Started: July 30, 1962
Type: Five daily grab samples per week

Date	μμc Radium-226/liter
1962	
July 30-Aug. 31	0.16
Sept. 4-7	0.16
Sept. 10-14	0.16
Sept. 17-21	0.16
Sept. 24-28	0.16